

treatment of metal including the steps of: conducting a primary processing (accumulation processing) in which a pressed powder electrode, which is an electrode for electric discharge surface treatment formed by compressing powder of WC (tungsten carbide) and Co (cobalt), is used; and conducting a secondary processing (remelting processing) in which the electrode is replaced with an electrode made of copper, the electrode consumption of which is relatively small. According to this method, it is possible to form a hard coat having a strong adhering force with respect to steel, however, it is impossible to form a hard coat having a strong adhering force with respect to sintered material such as cemented carbide.

However, according to the investigations made by the present inventors, the following knowledge has been found out. When an electrode for electric discharge surface treatment made of material such as Ti (titanium) capable of forming a hard carbide is used and electric discharge is generated between the electrode and metal of a workpiece, it is possible to form a strong hard coat on the metal surface of the workpiece without being subjected to the process of remelting. The reason why the strong hard coat is formed on the metal surface is that the electrode material, which has consumed by electric discharge, reacts with C (carbon) which is a component of processing

solution, so that TiC (titanium carbide) can be created. Also, the following knowledge has been found out. When a pressed powder electrode, which is an electrode for electric discharge surface treatment made of metal hydride such as TiH_2 (hydrogenation titanium), is used and an electric discharge is generated between the pressed powder electrode and the metal of a workpiece, it is possible to form a hard coat more quickly, the adhering property of which is higher than that of a case in which Ti is used. Further, the following knowledge has been found out. When a pressed powder electrode, which is an electrode for electric discharge surface treatment in which hydrogenation compound such as TiH_2 is mixed with other metal or ceramics, is used and an electric discharge is generated between the pressed powder electrode and the metal of a workpiece, it is possible to quickly form a hard coat of various hardness and abrasion resistance property.

The above method is disclosed, for example, in Japanese Patent Laid-Open No.192937/1997. Fig.4 is an arrangement view showing an example of the device used for the electric discharge surface treatment described above. In Fig.4, reference numeral 1 is a pressed powder electrode which is an electrode for electric discharge surface treatment composed of compressed powder of TiH_2 , reference numeral 2 is a workpiece, reference numeral 3 is a

processing tank, reference numeral 4 is a processing solution, reference numeral 5 is a switching element for switching a voltage and current impressed upon between the pressed powder electrode 1 and the workpiece 2, reference numeral 6 is a control means for controlling by turning on and off the switching element 5, reference numeral 7 is an electric power unit, reference numeral 8 is a resistor, and reference numeral 9 is a hard coat which has been formed. According to the above structure, when an electric discharge is generated between the pressed powder electrode 1 and the workpiece 2, the hard coat 9 can be formed on a surface of the workpiece 2 made of steel or cemented carbide by the electric discharge energy. In this structure, the switching element 5, control circuit 6, electric power unit 7 and resistor 8 correspond to an electric power unit for electric discharge surface treatment to determine a wave-form of a pulse of an electric discharge current when the electric discharge surface treatment is conducted.

In the above conventional electric power unit for electric discharge surface treatment, an electric discharge current pulse, the wave-form of which is rectangular, is basically used. As shown in Fig.5, when peak value I_p of the electric discharge current and pulse width T are